

CHAPTER 7

BASIS OF PROJECT DEVELOPMENT

In addition to process design criteria, the economic evaluation of facility treatment alternatives is an important tool for project development and making wastewater management decisions. The economic evaluation methods described in this chapter have been used to help determine the most cost-effective wastewater program for the City of Lincoln. Many of the planning considerations documented in this chapter were developed in project workshop meetings with the City staff held during preparation of this report.

2002 Lincoln-Lancaster County Comprehensive Planning

The recently updated and revised Lincoln-Lancaster County Comprehensive Plan presents policies for future growth and helps guide future decisions and development within the community. The wastewater management systems developed and evaluated as part of this study are consistent with the 2002 Lincoln-Lancaster County Comprehensive Plan. It is intended that planning recommendations and costs identified in this document be used in future citywide planning efforts.

Design Period and Project Staging

Two planning periods were used in analyzing the cost of various treatment facility alternatives. A 25-year base planning period from 2000 through the year 2025 was used for planning wastewater treatment facilities. A 50-year period from 2000 through 2050 was also used for planning considerations because many facilities, particularly pipelines and structures, have a 50-year design life.

Economic Evaluation

Present Worth Analysis. Because some of the projected costs will be incurred today and some incurred in the future, a reasonable adjusting method must be used to reflect the fact that a dollar's purchasing power diminishes over time. Present worth analysis has been used to provide meaningful cost comparisons for alternative courses of action.

It should be recognized, however, that the economic life assigned to the various wastewater system components is only estimated to facilitate cost comparison and may not accurately reflect a component's true useful life. The following sections describe the cost estimating methods used in this report.

Assigning Costs. Where appropriate, costs from previous studies and the 1995 Lincoln Wastewater Facility Plan have been used in the development of this facility plan update. These data are footnoted to indicate the source of information. All costs have been adjusted to represent 2002 dollar values.

Capital Costs. Actual projects were used as a basis for much of the cost estimating data for wastewater treatment process equipment and various plant-wide improvements. Other cost sources include manufacturers, suppliers of material and equipment, local contractors, and project data provided by professional journals and construction publications. The previous facility plan, the 1991 Odor Evaluation, and previous estimates generated by Brown and Caldwell were used to estimate costs, where appropriate.

All costs presented in this report were derived using the same level of estimating accuracy and, therefore, are comparable. Actual construction costs may differ from the estimates presented, as a result of specific design requirements and the economic climate at the time a project is bid. Specific cost estimating factors are discussed in the following paragraphs.

Cost Index. Cost estimates were obtained from projects in different locations and in different years. In order to bring all costs to a common, comparable base, the *Engineering News-Record* (ENR) Construction Cost Index was used. This is a common, industry-accepted means for adjusting costs from different time periods and locations. The ENR Construction Cost Index tracks construction costs in twenty-two U.S. cities and is computed from construction, material, and labor costs.

Contingencies. Feasibility studies and master plans represent a relatively “rough” level of construction cost estimating. Pre-bid construction cost estimates, which are based on well-defined engineering drawings and specifications, represent a much more refined cost estimate.

The American Association of Cost Engineers (AACE) has developed levels of accuracy for various stages in construction cost estimation. The AACE cost estimation accuracies are presented in Table 7-1.

Table 7-1. Construction Cost Estimation

Type of Estimate	Anticipated Accuracy
Order of magnitude estimate (facilities plan)	+50% to -30%
Budget estimate	+30% to -15%
Definitive estimate	+15% to -5%

The AACE accuracy levels confirm that the fewer the unknowns and the closer to construction date, the more accurate the cost estimate becomes.

To adjust for the level of uncertainty associated with a particular project, contingency funds are commonly included. As a project becomes better defined, there become fewer unknowns and the magnitude of the contingency allocation decreases. In general, facility planning reports include contingencies of 20 to 30 percent of the total equipment and construction costs, whereas a design development document may only include a contingency of 10 to 20 percent.

The Theresa Street and Northeast WWTF sites are the expected areas for much of the anticipated construction. Actual alignments for new pipelines have not been identified. Therefore, physical land characteristics such as slope, groundwater depth, geotechnical characteristics, and utility conflicts are unknown and cannot be included in the current cost estimates. Such uncertainties are accounted for in the contingency allocation. Based on the level of unknowns associated with the projects identified in this facility plan update, a contingency factor of 25 percent has been included in the construction costs presented in this report.

Engineering, Legal, and Administration. Often times legal services are required to coordinate construction efforts with local government agencies, to facilitate land purchases, and easement and right-of-way transactions. Similarly, ancillary engineering services such as special investigations, surveys, foundation reports, location of interfering utilities, detailed design, preparation of plans and specifications, construction inspection and materials testing, start-up assistance, and operations and maintenance (O&M) manual preparation may be required. These potential legal fees and ancillary engineering services were not included in the construction cost estimates. Finally, administrative effort will also be required to coordinate the engineering and legal efforts of all projects. A contingency factor of 25 percent has been used to account for engineering, legal, and administrative costs for projects described in this report.

Collection System

Construction cost estimates for collection system projects were developed based on pipeline size, general character of the terrain, and historical cost for similar facilities in the Lincoln area. The cost for a particular pipeline may vary depending on the final route selected, the type of pipe used, and the method of construction.

The wastewater collection system improvement costs presented in this facilities plan are general planning level costs and should be refined during the preliminary design phase of implementation.

Treatment Facilities

Many of the construction cost estimates presented here are based on unit process costs derived from construction costs for other projects with similar wastewater treatment processes and adjusted appropriately to reflect specific conditions in Lincoln. For example, a typical secondary clarifier may be estimated to cost \$75 per square foot of surface area. However, these unit costs can vary widely from project to project because of such factors as unit size, seismic design requirements, groundwater levels, foundation stability, mitigation factors, aesthetics, and owner

preferences. Considerable judgement is required to arrive at unit process costs that most closely reflect the conditions for the City of Lincoln.

Construction costs of general items are estimated as a percentage of the total cost since the necessary field studies and designs are not yet complete. This allows for a clearer definition of the required work as described below.

Site Work. Site work includes such items as clearing and grubbing, excavation, grading, major drainage facilities, roadways, curb and gutter, sidewalks, landscaping, and fencing. A 15 percent factor is applied to the total equipment and construction budget to cover site work expenses.

Foundations. Foundation needs are determined by detailed geotechnical investigations. Actual construction costs may include such items as preloading to hasten soil consolidation, imported materials, foundation piles, foundation backfill, and drainage requirements. A factor of 10 percent has been applied to the total equipment and construction budget to account for foundation costs.

Yard Piping. Yard piping generally includes all piping between structures. This piping may be water, sewer, gas, minor drainage, and telecommunications lines, as well as process piping. A factor of 15 percent times the total equipment and construction budget has been used to accommodate yard piping costs.

Electrical and Instrumentation. Electrical and instrumentation costs can vary widely from plant to plant depending on owner preferences and the complexity of the treatment processes, control systems, etc. Instrumentation costs are higher if the plant requires a high level of monitoring to control the process. The level of automation also affects instrumentation costs. A factor of 20 percent has been applied to the total equipment and construction cost to cover electrical and instrumentation items. This reflects a moderate level of instrumentation.

Treatment Facilities. Additional land for new treatment facilities required beyond 2025 was assumed to cost \$10,000 per acre. This value only corresponds to the purchase of land itself, and does not reflect the cost of acquiring easements and rights-of-way for the pipelines required to convey wastewater to the facility site. No attempt has been made to estimate the amount or cost of land that may be purchased for use as a buffer around the facilities.

Land. The City owns the land required for expansion of treatment facilities to serve projected 2025 needs.

Collection Facilities. The cost of pipeline projects includes cost for right-of-way and easement acquisition. These costs were based on the following easement requirements:

- Trunk Lines (42-inch diameter and larger)
Permanent Easement - 40 feet wide
Temporary Construction Easement - 150 feet wide

- Collection Lines (36-inch diameter and smaller)
Permanent Easement - 20 feet wide
Temporary Construction Easement - 100 feet wide

The cost of permanent easements was taken to be \$9,000/acre. The cost of temporary construction easements was taken to be \$1,000/acre.